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ABSTRACT

To examine the importance of being literate in the technology of telecommunication, the attitudes of three populations were studied: college students, academics, and industry professionals. Altogether 266 names and addresses were compiled. Using a quota strategy, industry professionals were drawn from several segments of the telecommunication industry. Respondents were asked to judge how important it was to have understandings of at least one technology, and many or most of the technologies in the following categories: message creation/origination, message delivery/wire, message delivery/wireless, message processing, message storage/retrieval, and message reception/display. Respondents were also asked to indicate how satisfied they were with the depth of their knowledge in each category. Several tentative conclusions were drawn from the results: (1) students were more likely than educators or industry professionals to think skills or abilities related to telecommunication technology are important, (2) students were more likely than educators or industry professionals to think it is important to understand various telecommunication technologies, (3) industry professionals were most satisfied with their current level of technical knowledge, and (4) educators had the least favorable attitudes toward technology. (HOD)

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DEFINING A CONSTRUCT OF TELECOMMUNICATION TECHNOLOGY LITERACY AND TESTING FOR DIFFERENCES AMONG STUDENTS, EDUCATORS AND INDUSTRY PROFESSIONALS--A PILOT STUDY

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ABSTRACT

Not many would argue with the proposition that we are now in the "information age." In order to function well in this type of environment, we need to understand the limitations and capabilities of telecommunication technology, particularly in the case of those choosing careers in the field. At times it may become somewhat problematic trying to decide what one needs to know in order to be competent in one's profession and perhaps society in general. This certainly applies to the fast moving, technology-based field of telecommunication.

To understand the importance of being literate in the techology of telecommunication, the attitudes of three populations were studied: college students, academics and industry professionals. To facilitate the research, an ad hoc operational definition of "telecommunication technology literacy" was created and this construct was tested for reliability. The three populations were then compared for differences in their attitude towards telecommunication technology literacy.

The findings suggest several tentative conclusions. Students appear to be more likely than educators or industry professionals to think skills or abilities related to telecommunication technology are important to have. Students are also more likely than educators or industry professionals to think it is important to understand various telecommunication technologies. Industry professionals are most satisfied with their current level of technical knowledge. And finally, educators have the least favorable attitudes toward technology.

This paper points to a need for further research in the area of telecommunication technology literacy to understand differences among these groups. This understanding may lead to better appreciation for the needs of students, educators and industry professionals in identifying and setting literacy priorites related to their study and application of telecommunication technology.

INTRODUCTION

The study of telecommunication technologies has tended to focus on the political, social, economic and technical aspects. A number of authors have done a fine job exploring these dimensions in various levels of analyses (See e.g.: Baldwin and McVoy, 1983; Dizard, 1982; Williams, 1982; Martin, 1977; Pool, 1977). More recently, others have attempted to synthesize much of the research literature on the new media into a single volume (Rice et al., 1984). These studies of the technology of telecommunication and information systems tend to emphasize the interaction of different kinds of technologies upon existing systems and the capabilities of the new media, and deemphasize treatment of the actual technology.

Not many would argue with the proposition that we are now in the "information age." In order to function well in this type of environment, we need to understand the limitations and capabilities of telecommunication technology, particularly in the case of those choosing careers in the field. At times it may become somewhat problematic trying to decide what one needs to know in order to be competent in one's profession and society in general. This certainly applies to the fast moving, technology-based field of telecommunication.

Roy (1983) argues that, "for the last 30 years, the leaders of academic science and engineering have treated the problem of technological literacy with what amounts to benign neglect." He cites a recent estimate by the National Science Foundation that the programs necessary to reverse the declining trend in national science and math scores would cost $150 billion. If there is a

problem generally with producing technologically literate people, we in the telecommunication and information industry might wonder how literate we are with respect to our own technologies.

One might think that our colleges and universities have the problem well in hand by now. And in fact several surveys of major academic institutions initially bear this out (Smith, 1984; Swan and Hoy, 1983; Liechti, 1980). It appears that over three-quarters of these four year schools provide some type of technology education in their curricula. The Swan and Hoy study, in particular, looked at the needs of industry as compared to what type of graduates were being produced.

Only the major schools offer a separate track or courses in telecommunication technologies. Most schools integrate the treatment of technology topics into the context of existing courses. In some senses, it may be a better approach to integrate technological concepts into other coursework, as students may avoid overtly technologically oriented courses due to various math, science or other anxieties related to technology (Rauschenberg, 1984; Steele and Reinsch, 1984; Mauer and Simonson, 1984; Christiansen, 1980).

Once we realize that most major colleges offering programs in the telecommunication area also provide some type of technology component in the curriculum, the next logical question deals with the nature of this technology component--what is actually being taught? In most cases, the economics, policy and social impact of telecommunication technologies may be studied, but not the actual technology itself. Smith (1984) found that of

24 topics ranked, the 23rd in importance to educators was the technical/engineering aspect of new and existing forms of telecommunication.

PURPOSE

To understand the importance of being literate in the technology of telecommunication, the attitudes of three populations were studied: college students, academics and industry professionals. To facilitate the research, an ad hoc operational definition of "telecommunication technology literacy" was created and this construct was tested for reliability. The three populations were then compared for differences in their attitudes toward telecommunication technology literacy.

The findings of this research might be interesting to educators who are considering how to integrate treatment of telecommunciation technology into their curricula, either with separate courses or tracks, or by integrating these topics into existing courses. Students may wish to compare what they think is important in terms of technical concepts and knowledge, to what their professors and prospective employers think. And finally, industry professionals can assess how their peers evaluate the importance of being technically literate in the field, as well as learning of the attitudes of those in academia.

In addition to providing some preliminary findings about how important these populations evaluate various aspects of telecommunication technology to be, the literacy construct developed here may be useful in future research which deals with attitudes toward telecommunication technology.

METHODS

Sample

Three populations were selected for study in this research project -- educators, students and telecommunication industry professionals. Due to the difficulties in obtaining usable sampling frames and survey administration constraints, no attempt was made to obtain truly random samples.

The industry sample was drawn from a variety of sources. Altogether 266 names and addresses were compiled. Names were drawn from alumni records of a major midwestern university's department of telecommunication; *BROADCASTING YEARBOOK 1984*; and from colleagues. A quota strategy was used such that industry professionals were drawn from several segments of the telecomunication industry. These segments included management level people at advertising agencies; radio and television station managers; engineering consultants; group owners; networks; satellite operators; and cable multiple system operators. An attempt was made to select managers in several industry segments so that their diverse and mid to upper level management experiences could be tapped.

The sample of educators was also drawn from several sources. The chairpersons of mass communication departments at Big 10, Big 8 and PAC 10 schools were included. Also, professors listed in the directories of the technology special interest groups of the International Communication Association and the Association for Education in Journalism and Mass Communication were added to the

sample. Using the most recent Broadcast Education Association directory of schools (published in 1981), chairpersons at schools with 100 or more mass communication majors were also included. Altogether 620 names were compiled from the several sample frames used.

Professors contacted at three Big 10 universities agreed to distribute self-administered questionnaires to both undergraduate and graduate students. A self-administered questionnaire was mailed to the industry professionals and educators. Students were asked to complete the questionnaire during class time near the end of Fall term 1983 and the beginning of Winter term 1984. Two questionnaires were mailed to the educators and industry professionals--these people were asked to pass along the extra questionnaire to a colleague of theirs. This strategy was adopted to increase the sample base to include members not otherwise accessible to the researchers. Usable returns were obtained from 100 educators, 123 industry professionals and 133 students. One follow-up letter was sent to the educators and professionals to solicit further responses.

Instrumentation

One of the major objectives of this research was to operationalize a construct of telecommunication technology literacy. We approached this problem by assuming that there were three dimensions to this construct--cognitive, affective and ability. The final instrument contained 39 items to represent these domains. A full listing of these items appears in Appendix A. Most of the items were developed ad hoc. Some items were

derived from standard semantic differential scales (Osgood, Suci, and Tannenbaum, 1958). The cognitive and behavioral measures were not scaled in such a way that individuals would be rated on their own literacy. Instead, the items were scaled to reflect what cognitive and behavioral aspects of respondents themselves felt to be important in their professional lives with respect to telecommunication technology literacy.

Ability

The ability dimension of telecommunication technology literacy was operationalized in terms of various abilities related to the operation and analysis of technical equipment. Respondents were asked to rate the importance of each ability on a seven point Likert-type scale (7=very important; 1=not very important). The types of abilities ranged, for example, from the ability to operate audio consoles to the ability to use formulas to calculate capabilities and limitations of electronic equipment.

Cognitive

The cognitive items were generated by devising a six category scheme for classifying telecommunication technologies and asking respondents to judge how important it was in their professional lives to have an understanding of the technologies in each category. Items were included to measure how important it was to have an understanding of "at least one" of the technologies in each category. Respondents were also asked to judge how important it was to have an understanding of "many or most" of the technologies in each category.

The six category scheme was developed from the perspective that the message is central to any system of telecommunication, whether it be digital, analog, voice, video or data. The categorization of telecommunication technology in this system was based on the relationship between the message and the technology. The six categories thus developed (including examples) were:

1. **Message creation/origination:** cameras, microphones, computer keyboard, heat sensor, burglar alarm sensor, fire sensor.

2. **Message delivery/wire:** telephone lines, coaxial cable, fiber optics.

3. **Message delivery/wireless:** broadcasting, microwave, satellite, cellular radio.

4. **Message processing:** amplifiers, consoles, video switchers, computers, special scrambling/descrambling systems.

5. **Message storage/retrieval:** recording/playback systems, storage media.

6. **Message reception/display:** radio receivers, television monitors/receivers, high fidelity audio systems, hard copy printout.

In addition to asking the respondents to judge how important it was to have understandings of at least one and many or most of the types of technologies in each category, they were also asked to indicate how satisfied they were with the depth of their knowledge in each category. This was done using a seven point Likert type scale (7=very satisfied; 1=not very satisfied).

Affective

To measure the affective dimension of the telecommunication technology literacy construct, 15 semantic differential items were used. These items were largely based on the pioneering work

of Osgood, Suci and Tannenbaum (1958). Additional items or slightly modified items were also included.

Reliability

The final instrument, after going through several pretests using students, industry professionals and colleagues as respondents, contained five sets of summated scales. Cronbach's alpha was computed for each of these scales and after deleting several items, each of the scales eventually had alpha values ranging from .708 to .928 across the three samples. In the early stages of research, a Cronbach's alpha value of .7 or above is deemed acceptable as a criterion for determining that a scale is reliable (Nunnally, 1978). The reliability analyses for the five scales for each sample are presented in Appendix B.

RESULTS

To compare the sample means of educators, students and industry professionals on the five summated scales, analyses of variance (ANOVA) were used. All analyses were conducted on a Data General Eclipse minicomputer using the SPSS Release 9 version of the ONEWAY subprogram for computing ANOVAs. A .05 signficance level was selected prior to testing. In addition to the ANOVA analyses for producing omnibus F tests, post-hoc tests for determining significant directional differences among group means were also performed using the Scheffe option in the ONEWAY program. Omega squared, which is an index of the magnitude of the treatment effects, is also reported. This measure is similar to explained variance and was largely developed by Hays (1963).

Skills

Table 1 reveals that educators, students and professionals have significantly different senses of what is important in terms of the skills that are important to have in the telecommunication industry.

Table 1. Importance of Skills to Careers in Telecommunication

SOURCE	DF	SS	MS	F	P
Between	2	3150.1215	1575.0610	19.905	.0000
Within	284	22472.4937	79.1285		
Total	286	25622.6100			

Omega squared= 11.6% (explained variance)

Possible scale scores on the SKILLS scale ranged from 7-49. Scheffe post-hoc analyses revealed that the student mean (25.815) was significantly higher than the educator mean (18.239) and the industry mean (19.958). The educator and industry means were not significantly different.

Knowledge of at Least One Technology

Respondents were asked to estimate how important it was to have an understanding of at least one technology in six categories of various kinds of telecommunication technologies. Table 2 contains these results.

Table 2. Importance of Understanding One Technology

SOURCE	DF	SS	MS	F	P
Between	2	483.3212	241.6606	3.598	.0284
Within	348	23373.1791	67.1643		
Total	350	23856.5000			

Omega squared= 1.5% (explained variance)

The possible range on this scale was 6-42. Scheffe post-hoc tests showed that the student mean (33.174) was significantly higher than the industry mean (30.413). The educator mean (31.684) was not different from either of the other groups.

Importance of Understanding Many or Most Technologies

Table 3 presents the analysis of how important the three groups felt it was to have an understanding of many or most of the technologies in the six categories described earlier. Again, the overall results are significant and group differences emerge.

Table 3. Importance of Understanding Many or Most Technologies

SOURCE	DF	SS	MS	F	P
Between	2	1080.2116	540.1057	6.166	.0023
Within	347	30395.4414	87.5949		
Total	349	31475.6500			

Omega squared= 2.9% (explained variance)

Like the previous scale, this scale had six items and therefore possible scale scores ranged from 6-42. In this case the student mean (30.235) was significantly higher than either the industry mean (26.317) or the educator mean (27.092). There was no difference between the industry and educator means.

Satisfaction With Depth of Knowledge

The next scale asked respondents to indicate how satisfied they were with the depth of knowledge they had with respect to the technologies in the six different categories. Again, Table 4 reveals that the analyses were significant and group differences emerged in the post-hoc analyses. With six items, scale scores could range from 6-42. In this case, the industry mean (28.492) was significantly higher than either the educator mean (23.557) or the student mean (22.827). The student and educator means were not significantly different.

Table 4. Satisfaction With Depth of Knowledgde

SOURCE	DF	SS	MS	F	P
Between	2	2317.4733	1158.7370	19.778	.0000
Within	349	20447.1680	58.5879		
Total	351	22764.6400			

Omega squared= 9.6% (explained variance)

Semantic Differential Scale

The last scale used in this study was composed of 14 semantic differential items. Individual items were rated on seven point scales, thus possible scale scores ranged from 14-98. Table 5 presents the results.

Table 5. Semantic Differential Scale--Evaluating Technology

SOURCE	DF	SS	MS	F	P
Between	2	821.6803	410.8401	4.302	.0143
Within	334	31898.0977	95.5063		
Total	336	32720.7800			

Omega squared= 1.9% (explained variance)

Higher scale means indicate a more positive attitude toward technology. The educator mean (68.333) was significantly lower than the student mean (71.622) or the industry mean (72.009). There was no difference between the student and industry means.

DISCUSSION

The omnibus F tests produced in the ANOVAs yielded highly significant results when comparing the three samples across the five scales. Significant group differences were also found. Again, we caution the reader against overinterpreting these results for two reasons. First, these tests require a strictly random sample to be used. This assumption was violated. Second, while the significance levels achieved with these tests are impressive with relatively small sample sizes, it should also be

noted that the magnitude of the significant effects tends to be small. The omega squared statistic indicates that the explained variance achieved in this study ranges from 1.5% to 11.6%.

However, in spite of these caveats the results seem promising in terms of future research prospects. We now have some evidence to believe that these three populations may be different in terms of their perspectives toward telecommunication technology literacy.

Students feel that skills are much more important than either the educators or industry professionals do. This is a rather intuitive finding, especially to anyone who has taught at the college level. Students, in many cases, seem drawn to the skills courses which offer something tangible and easily demonstrable. While these skills may be important, educators and professionals seem to agree that other aspects of telecommunication technology literacy are perhaps more important.

The six category scheme for classifying the various technologies of telecommunication is useful to condense a growing number of means for handling messages. Interestingly, students think it is more important than educators to have an understanding of at least one technology in each of these categories. And students again think it is more important than either educators or professionals to have an understanding of many or most of the technologies in the six categories. Students clearly have a sense that it is important to be literate in the technology of telecommunication, even more than their professors and prospective employers. Perhaps they are slightly ahead of their time?

When we look at how satisfied the three groups of respondents were with the depth of understanding of telecommunication technology, again the students are less satisfied than the industry professionals. Educators are also less satisfied than the professionals. One explanation for this phenomenon is that those already in the industry have developed whatever skills and knowledge they believe they need. Students, on the other hand, may not know what turn their careers will take and so feel compelled to hedge their bets by covering as many areas as possible.

In terms of the evaluative attitudes the groups maintain toward technology, it was interesting to note that educators are the least favorable in their evaluation of technology. This should be explored further. If replicated, this might be the source of bias in the classroom.

Further work should be done to develop instrumentation for measuring telecommuncation technology literacy. The present work was aimed more at determining how important various components of this construct are to three populations. The major point of this research was to determine what students should be taught in order to be technically literate in the field of telecommunication. However, given the findings observed here, it may be worth it to further investigate some of the between group differences. Perhaps educators and industry professionals need to become more technically literate as well as students!

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APPENDIX A

Skills Items(7=very important; 1=not very important)

1. Ability to operate audio consoles, TV cameras, tape machines and similar production equipment.*
2. Ability to perform simple computer operations (use a terminal for data entry, search, retrieval, etc.).*
3. Ability to perform complex computer operations (write and use computer programs, etc.).
4. Ability to understand simple schematic diagrams.
5. Ability to evaluate the performance of equipment.
6. Ability to detect and diagnose simple problems in electronic equipment.
7. Ability to propose modifications to improve electronic equipment peformance.
8. Ability to modify existing electronic systems (design new circuits, build kits according to instructions, etc.).
9. Ability to use formulas to calculate capabilities and limitations of electronic equipment (frequency response, memory capacity, rate of information transfer, transmission distances, interference patterns, power requirements, etc.).

Semantic Differential Items

1. Fair/Unfair**
2. Weak/Strong*
3. Worthless/Valuable
4. Pleasant/Unpleasant**
5. Complete/Incomplete*
6. Bad/Good
7. Safe/Dangerous**
8. Humorous/Serious*
9. Clean/Dirty**
10. Tasteless/Tasteful

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Semantic Items (cont).

11. Contemporary/Noncontemporary
12. Positive/Negative**
13. Soft/Hard*
14. Optimistic/Pessimistic**
15. Harmful/Beneficial
16. Essential/Not essential**
17. Personal/Impersonal**
18. Intimidating/Friendly

Cognitive Items

1. Message creation.
2. Message delivery/wire.
3. Message delivery/wireless.
4. Message processing.
5. Message storage/retrieval.
6. Message reception/display

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*Items dropped from further analysis
**Items reverse coded

APPENDIX B

Reliability Analyses of Scales Used

Scale/Group	Items	Cases	Mean	Cronbach's Alpha Unstd.	Std.
SKILLS(7=very important; 1=not very important/scale range: 7-49)					
Student	7	124	25.815	.839	.838
Educator	7	67	18.239	.708	.742
Industry	7	96	19.958	.872	.878
ONETECH(7=very important; 1=not very important/scale range: 6-42)					
Student	6	132	33.174	.838	.844
Educator	6	98	31.684	.901	.904
Industry	6	121	30.413	.861	.864
MANYTECH(7=very important;1=not very important/scale range: 6-42)					
Student	6	132	30.235	.883	.885
Educator	6	98	27.092	.920	.921
Industry	6	120	26.317	.904	.905
DEPTH(7=very satisfied; 1=not very satisfied/scale range: 6-42)					
Student	6	133	22.827	.892	.893
Educator	6	97	23.557	.928	.928
Industry	6	122	28.492	.875	.876
ATTITUDES(7 point semantic differential items/scale range: 14-98)					
Student	14	127	71.622	.811	.819
Educator	14	93	68.333	.854	.860
Industry	14	117	72.009	.850	.854